Guidelines for Management of Complex Situations

An Operational and Human Factors View
This presentation is based on the operational and human factors analysis of events involving complex situations … … within or beyond the scope of published procedures.

This synthesis provides an overview of observed factors and related prevention strategies in terms of:

- Situation recognition / crew diagnosis (warnings / cockpit effects)
- Procedures (access / contents / execution)
- Crew performance (actions / flight-path control)
Crew coordination:

Crew Coordination
Highlighting the Monitoring Role of the PNF
Contents

• Defining Complex Situations
• What do Statistics Tell Us?
• General Prevention Strategies
• Quotes from your Peers
• Situation Recognition / Crew Diagnosis
• Procedures Access / Contents
• Crew Performance
Defining Complex Situations
Unusual combination of abnormal / emergency procedures

Absence of related procedure

Absence of related or equivalent training

Absence of alert or cockpit effect

Alerts or cockpit effects disabled by the prevailing condition

Alert or cockpit effect not reflecting the prevailing condition
Defining Complex Situations - 2 / 2

- Situation not solved by existing procedure
- Aircraft system or ground equipment (e.g., navaid) left in maintenance mode
- Situations resulting from:
  - Seemingly unrelated multiple alerts involving several systems
  - Electrical transients (affecting multiple systems)
  - Maintenance errors
  - Common-cause beyond assumptions of system safety assessment
  - Inadvertent interaction with aircraft controls
What do Statistics Tell Us ?
## Factors in Approach and Landing Accidents

<table>
<thead>
<tr>
<th>Factor</th>
<th>% of Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate decision making</td>
<td>74 %</td>
</tr>
<tr>
<td>Omission of action or inappropriate action</td>
<td>72 %</td>
</tr>
<tr>
<td>Inadequate CRM practice (crew coordination, cross-check and backup)</td>
<td>63 %</td>
</tr>
<tr>
<td>Insufficient horizontal or vertical situational awareness</td>
<td>52 %</td>
</tr>
<tr>
<td>Inadequate or insufficient understanding of prevailing conditions</td>
<td>48 %</td>
</tr>
<tr>
<td>Slow or delayed crew action</td>
<td>45 %</td>
</tr>
<tr>
<td>Flight handling difficulties</td>
<td>45 %</td>
</tr>
<tr>
<td>Incorrect or incomplete pilot / controller communication</td>
<td>33 %</td>
</tr>
<tr>
<td>Interaction with automation</td>
<td>20 %</td>
</tr>
</tbody>
</table>

Source: Flight Safety Foundation - 1999
## Errors in Decision Making

**Note**

*Errors are listed in their time sequence during a typical event*

<table>
<thead>
<tr>
<th>Phase of Decision Process</th>
<th>Error Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perception and information gathering</td>
<td>3</td>
</tr>
<tr>
<td>Information decoding</td>
<td>6</td>
</tr>
<tr>
<td>Situation representation</td>
<td>2</td>
</tr>
<tr>
<td>Knowledge of and adherence to procedure</td>
<td>7</td>
</tr>
<tr>
<td>Incorrect or untimely decision making</td>
<td>1</td>
</tr>
<tr>
<td>Untimely or incorrect action</td>
<td>5</td>
</tr>
<tr>
<td>Absence of monitoring of action feedback</td>
<td>4</td>
</tr>
</tbody>
</table>

*Source: InfoPilote - 1996*
General Prevention Strategies
Assessing Exposure

- Identify and minimize influence factors and exposure:
  - Company factors
  - Personal factors
  - ATC factors
  - Airport factors and hazards
  - Weather and environmental hazards
Early Detection and Correction

- Provide recommendations for early detection and correction of possible non-normal conditions:
  - Anticipate
  - Detect
  - Correct
  - Decide
Define a common plan for the flight phase

- Identify and discuss factors such as:
  - Non-standard altitude or speed restrictions, environmental hazards, system malfunctions

Define agreed strategies (common objectives) for:
- Flight / energy management (next targets)
- Possible flight-phase-related contingencies

Brief several scenarios in readiness for anticipated ATC requests or other needs to change initial plans
Define **next targets** along the flight path:

- distance (position) markers
- defined objectives for next target:
  - Altitude, time, speed, configuration, vertical speed or flight path angle, power setting
- approaching the next target:
  - Monitoring, confirmation, decision-making, corrective action(s)
Detect

- Make time availability and reduce workload by avoiding:
  - Late briefings, unnecessary radio calls, non-pertinent intra-crew communications
- Monitor systems, using ECAM system pages
- Monitor flight path for early detection of deviations
- Provide timely and precise deviation callouts
- Be alert to adapt to changing weather conditions, approach hazards or system malfunctions
Correct

- Backup PF for effective corrective actions
- Take action, as required (e.g., during approach):
  - Use speedbrakes to correct excessive altitude
  - Extend landing gear to correct excessive airspeed
  - Extend outbound leg or downwind leg to provide more distance for approach stabilization
• **Be action-minded** (e.g., go-around):
  - Let’s be prepared for a go-around and we will land if:
    - the approach is stabilized, and
    - we have adequate visual references to make a safe approach and landing

• **Be action-prepared** (e.g., go-around):
  - Descent preparation, approach briefing, descent monitoring, task sharing, ...
  - Be ready to challenge initial plans and change plans as necessary
Know and Use **Safe Reference Values**

- Pitch / power relationship
- High and low buffet speeds
- Altitude capability for gross-weight (buffet margin)
- Gravity-feed altitude
- Engine-out level-off altitude versus MEA / MORA
- Windmilling and starter-assisted relight envelopes (altitude, speed or N2)
- Sector / segment MSA during approach
- Maximum recommended cross-wind for runway condition
Quotes from your Peers
About Taking Time to Make Time

- In an emergency, doing something wrong can be worse than doing nothing
- Whatever the situation or dilemma, hurry can be an unwelcome trouble-maker
- Emphasis should be on skill and composure instead of speed, and on avoiding being spring-loaded for disaster

Credit: PIA Safety Magazine
About Anticipation and Mitigation

- Prepare for the worst and hope for the best
- Declaring an emergency is an exceptional tool for a Captain, do not hesitate to use it when considered appropriate
- The first priority is to maintain or regain aircraft control, this is the bottom line
- Remember, you are not alone, time and conditions permitting, Dispatch can muster considerable help in dealing with [ a complex situation ]

Adapted from ACA Flightline
Situation Recognition / Crew Diagnosis
Warning / Cockpit Effects - Factors

- Absence of action feedback
- Mismatch between action and action feedback / cockpit effects
- Ambiguity between commanded function and function availability
- Difficulty in understanding system operation under unfamiliar conditions
- Not-announced and undetected entry errors
- Not-announced and undetected navigation deviations
Warning / Cockpit Effects - Strategies

- Monitor systems per SOP’s during cruise
- Heighten alertness and monitoring when in doubt
- Be ready for the most probable in-context and/or flight-phase-related scenario
- Look for more information to counter sparse, weak or ambiguous cues (cockpit effects)
Difficult interpretation of warnings involving several systems that have apparently nothing in common:

- Electrical causes
- Multiple smoke warnings
- Failures caused by loss of common data source or logic condition
Difficult assessment of exact prevailing condition:
  - Engine damage?
  - Fuel leak location?

Delayed recognition due to fatigue, distraction, preoccupation or lack of flight progress monitoring.
• Adopt a structured pattern for problem recognition

• Be aware that warnings involving several systems result from a non-obvious common cause

• Take time to gather cues and information to understand the prevailing condition

• Understand available cues to build-up a representation of the prevailing condition

• Attempt to validate genuine warnings from spurious indications
Be skeptical of your own actions:

- What may I have done that would have resulted in the observed condition?

Be aware of time factor in decision-making and action-taking

Perform a thorough damage assessment and, as applicable, a controllability check
Procedure Access / Contents / Execution
Procedure Access / Contents - Factors

- Reference to and coordination of multiple related or seemingly unrelated procedures

- Absence of related procedure, i.e.:
  - Absence of guidance on priorities, sequence of actions, safe values and limitations
  - Absence of condition-related information for approach and landing (under degraded conditions)
Procedure Access / Contents - Strategies

- Refer to QRH any time there is no ECAM procedure or ECAM does not appear to relate to or fully address the perceived condition
- If situation develops, carefully consider any additional alert or cockpit effect
- Be aware of possible conditional actions associated with advisory conditions
- Consider crew-awareness messages in decision-making process
- Be aware of the applicable pre-condition(s), if any, before resetting an affected system
Procedure Execution - Factors

- Condition not solved by existing procedure
- Correct action resulting in unanticipated response / condition
- Confusion on action sequence in case of lack of action feedback or unanticipated action feedback
- Absence of training on similar condition
Adhere to the long-known concept:
- Understand … Act … Verify

Validate / confirm results of actions (with available indications and cockpit effects) before proceeding with next action.

If procedure does not appear to relate to situation or to solve situation, start all over again to identify possible ambiguity or incorrect sequence.
Crew Actions - Factors - 1 / 2

- Delayed (late) response to warning or cockpit effect
- Late takeover from automation
- Absence of practice in operating aircraft systems in certain degraded conditions
- Cockpit activities at inappropriate times resulting in reduction in flight path monitoring
- Incorrect use of systems
- Inadvertent interaction with systems or automation
Crew Actions - Factors - 2 / 2

- Undetected action slips / lapses
- Undetected entry errors
- Untimely or inappropriate use of controls
- Rushed actions (i.e., without checking pre-conditions)
Attempt to **stabilize the situation** and limit further consequences, even if the prevailing condition is not fully identified and / or understood

Always adopt a **what if ?** attitude

Be aware that the **best** response to an undocumented condition is a **prudent** response

Consider that :

- A **correct** action is an action that is fully understood
- A **timely** action is an action that is performed taking into account the time factor ( i.e., no rush / no delay )
- Be aware of possible inordinate actions that may amplify the prevailing condition
- Be alert to recognize the results of incorrect data entries or selections
- Strive at understanding the interrelation between systems and their operational implications
- Revert to the system basic mode of operation if automated operation is not understood or doubtful
- Adhere to threats and errors management principles
Flight Path Control - Factors

- PF involvement in assessing situation … and not monitoring / maintaining aircraft attitude and trajectory
- Excessive flight control inputs (over control)
Maintain / restore aircraft control (first priority for PF)

Be aware of the aircraft response following crew action (i.e., trajectory, energy)

Remember the 3-P’s rule:
  - Pitch … Power … Performance

Be aware of applicable low / high buffet speeds, buffet margin, altitude capability

Be aware of applicable MEA / MORA / MSA

Be aware of nearest suitable airport
• Make careful and appropriate flight controls inputs (avoiding over control)

• If controllability may be affected:
  ▶ Consider performing a controllability check
  ▶ Limit bank angle to 15 degrees
  ▶ Prefer an extended straight-in approach with an early configuration set-up
"Be Aware to Be Mentally Prepared"

Adapted from Captain Neil JOHNSTON - Aer Lingus